



# **Studies of Laser-produced Tin plasmas for EUV Light Sources using Collective Thomson Scattering**

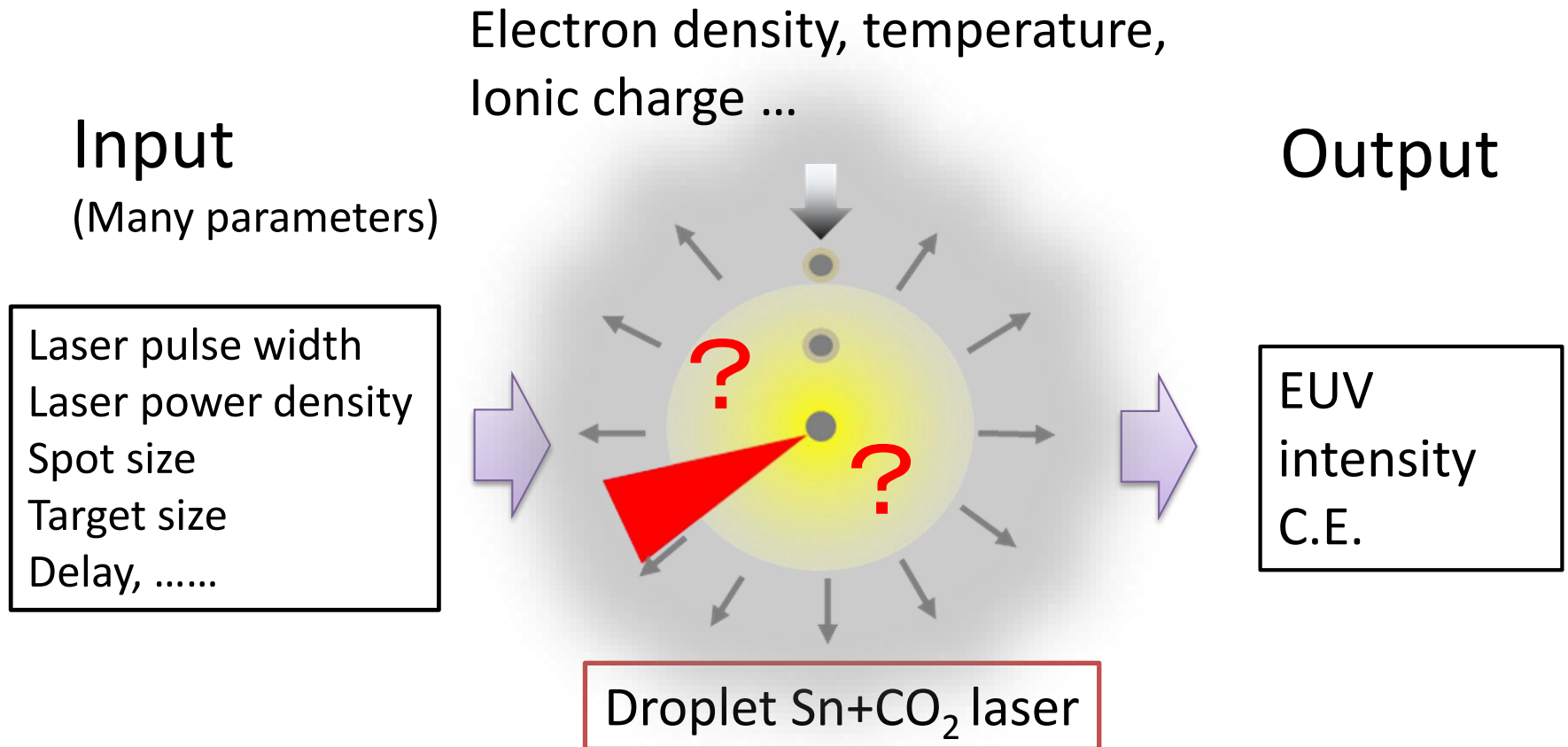
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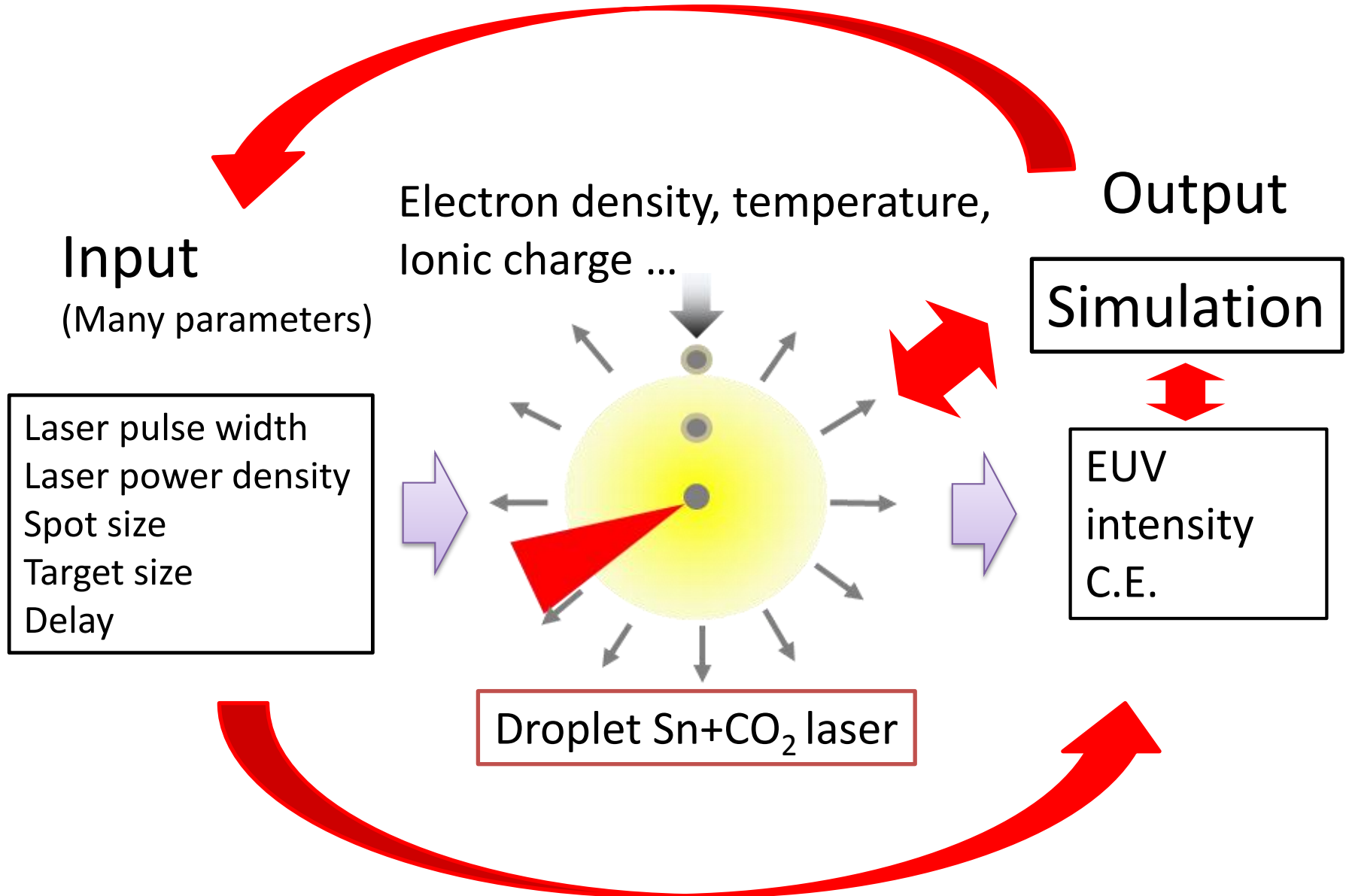
*2Gigaphoton Inc.*



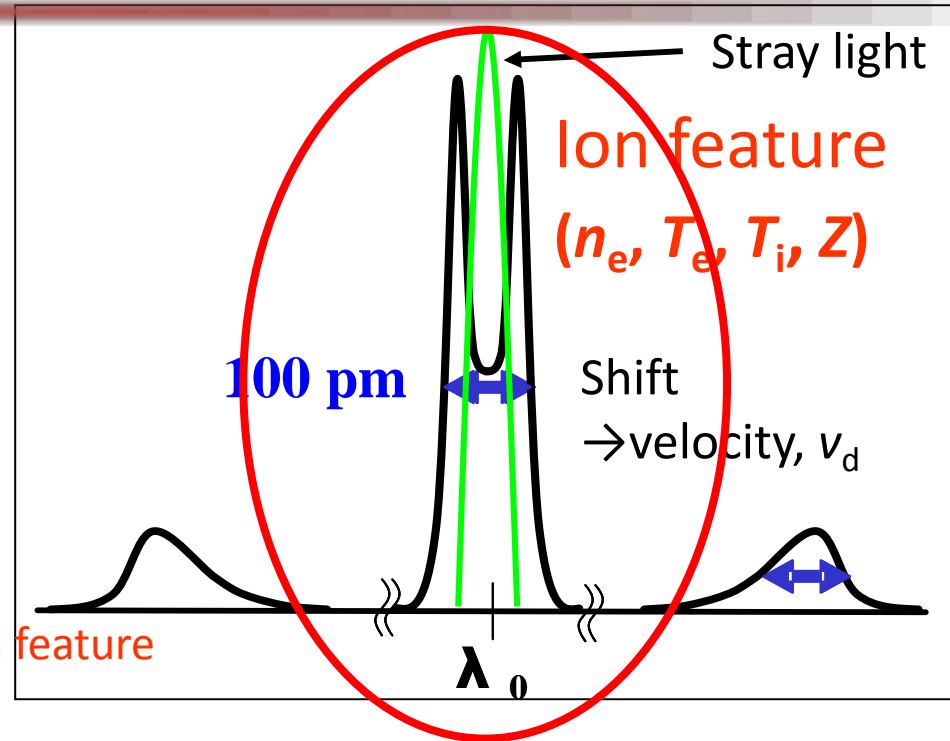
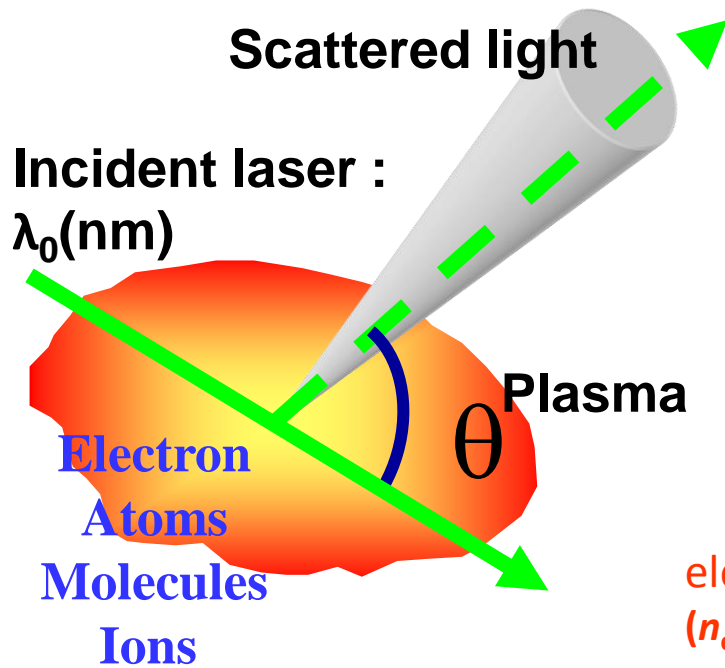
# Purpose of this study (Plasma diagnostics)



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# Method ; Laser Thomson scattering

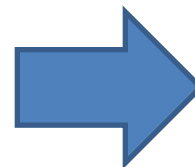


For Discharge EUV: E. R. Kieft et al., Rev. Sci. Instrum. 76, 093503 (2005)

Intensity  $\rightarrow \sim n_e$

Spectral width  $\rightarrow T_e T_i, Z$

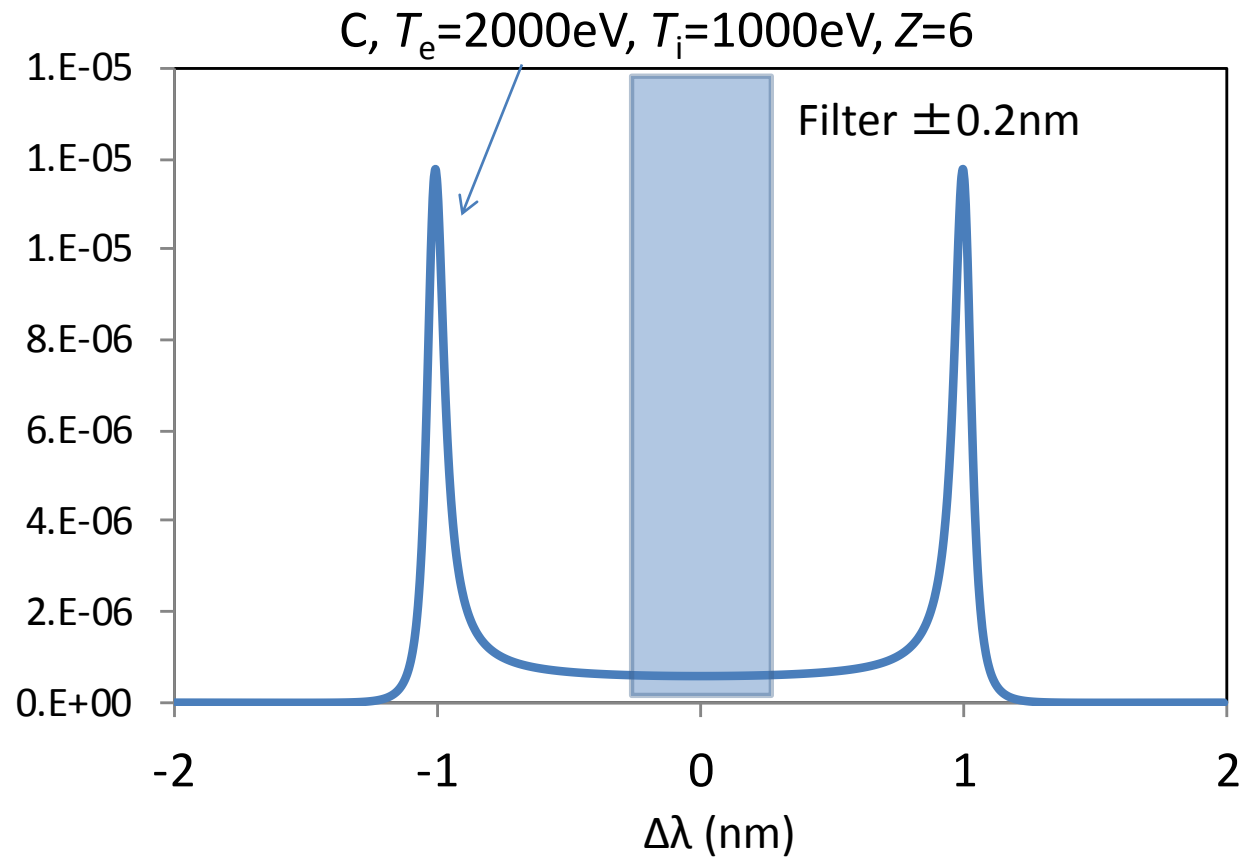
Spectral shape  $\rightarrow Z, T_e, T_i$



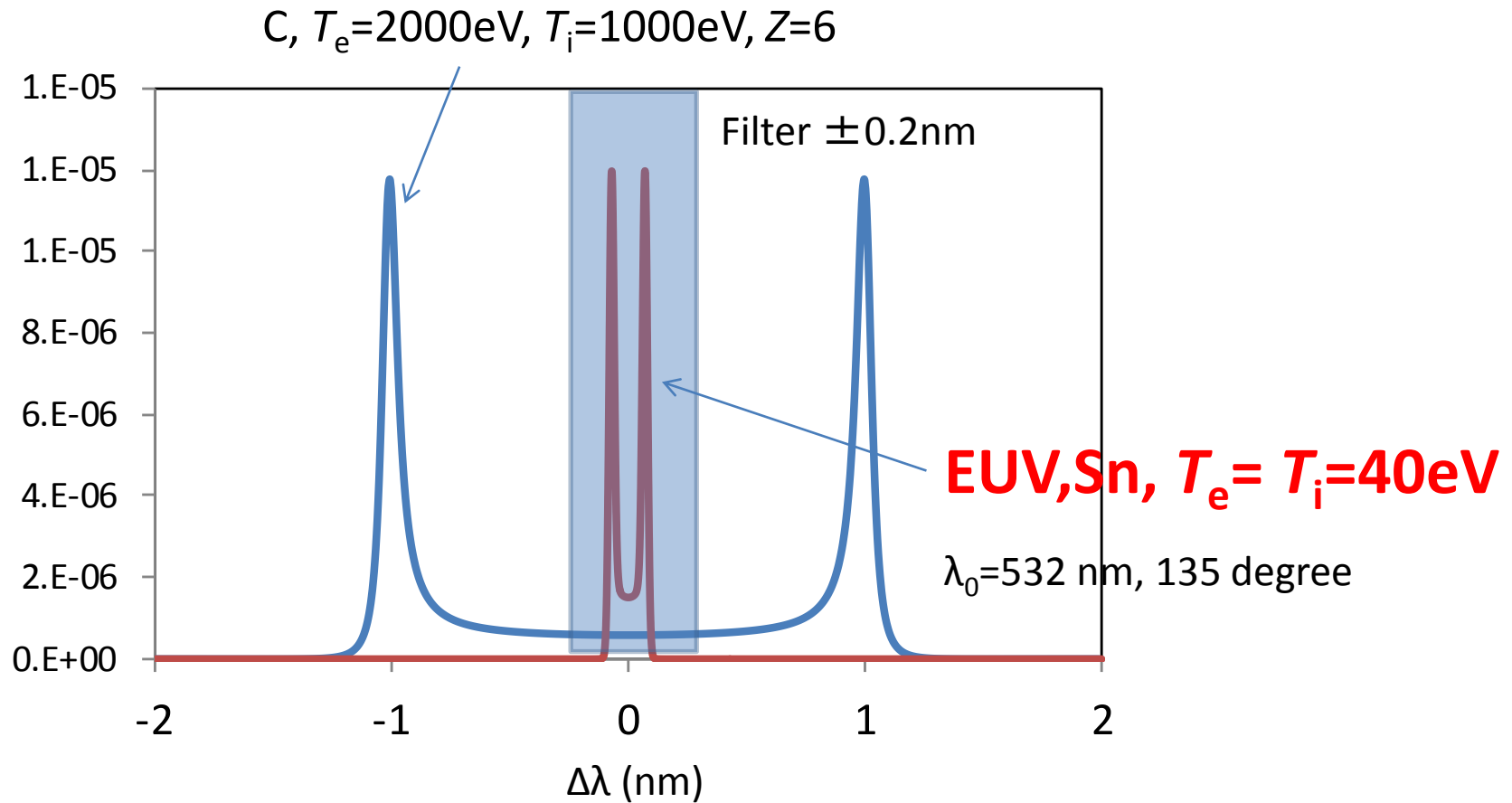
$n_e, T_e, Z$

Shift → velocity,  $v_d$

# Difficulty of Thomson scattering for EUV plasmas



# Difficulty of Thomson scattering for EUV plasmas



## Ion feature measurements

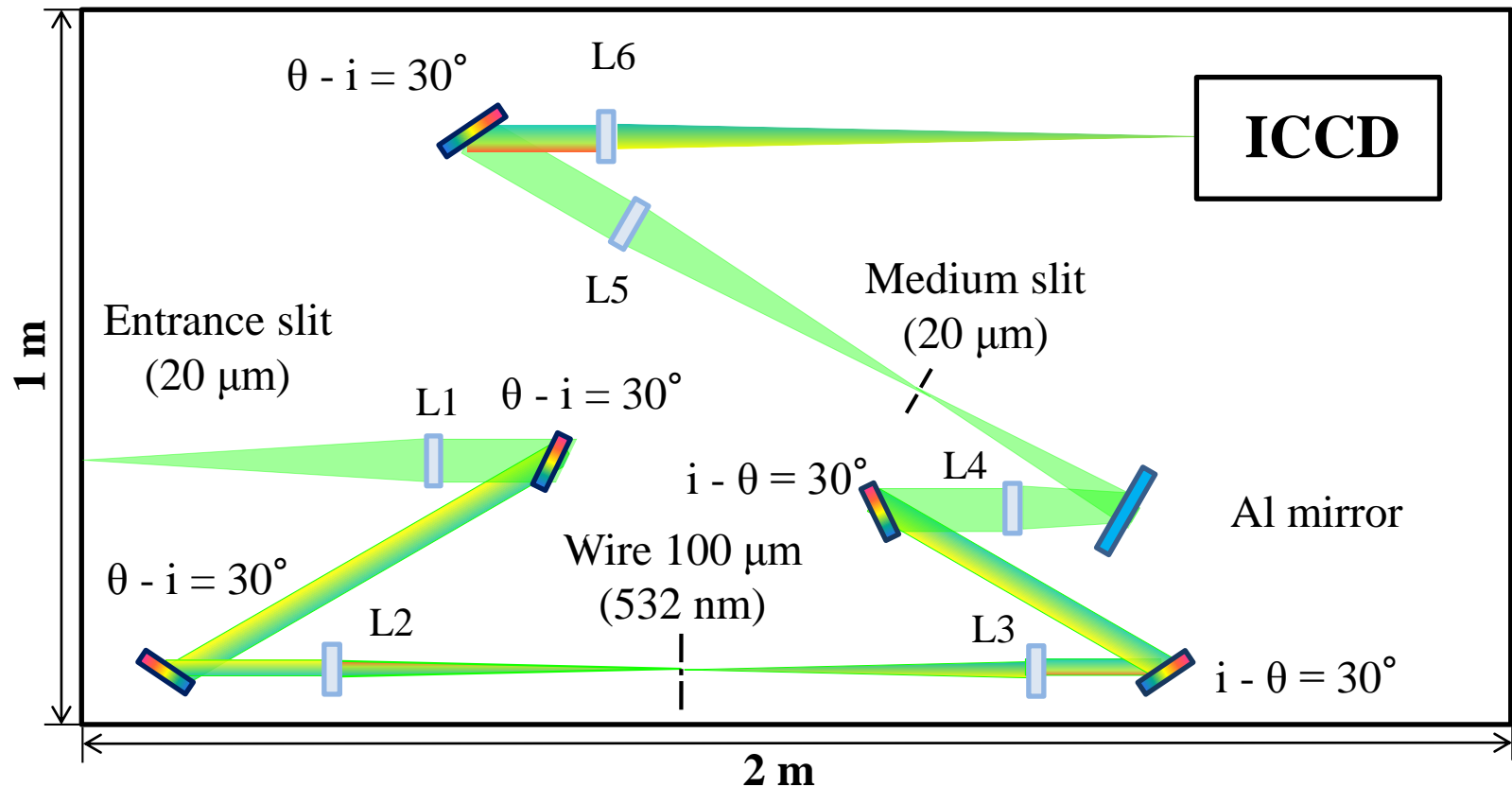
high spectral resolution ( $\sim 20\text{ pm}$ ),

sufficient stray light rejection (stray light from target material)

Cut only near laser wavelength ( $< 0.02\text{nm}$ )

# Development of LTS system for Sn plasmas

To overcome problems...

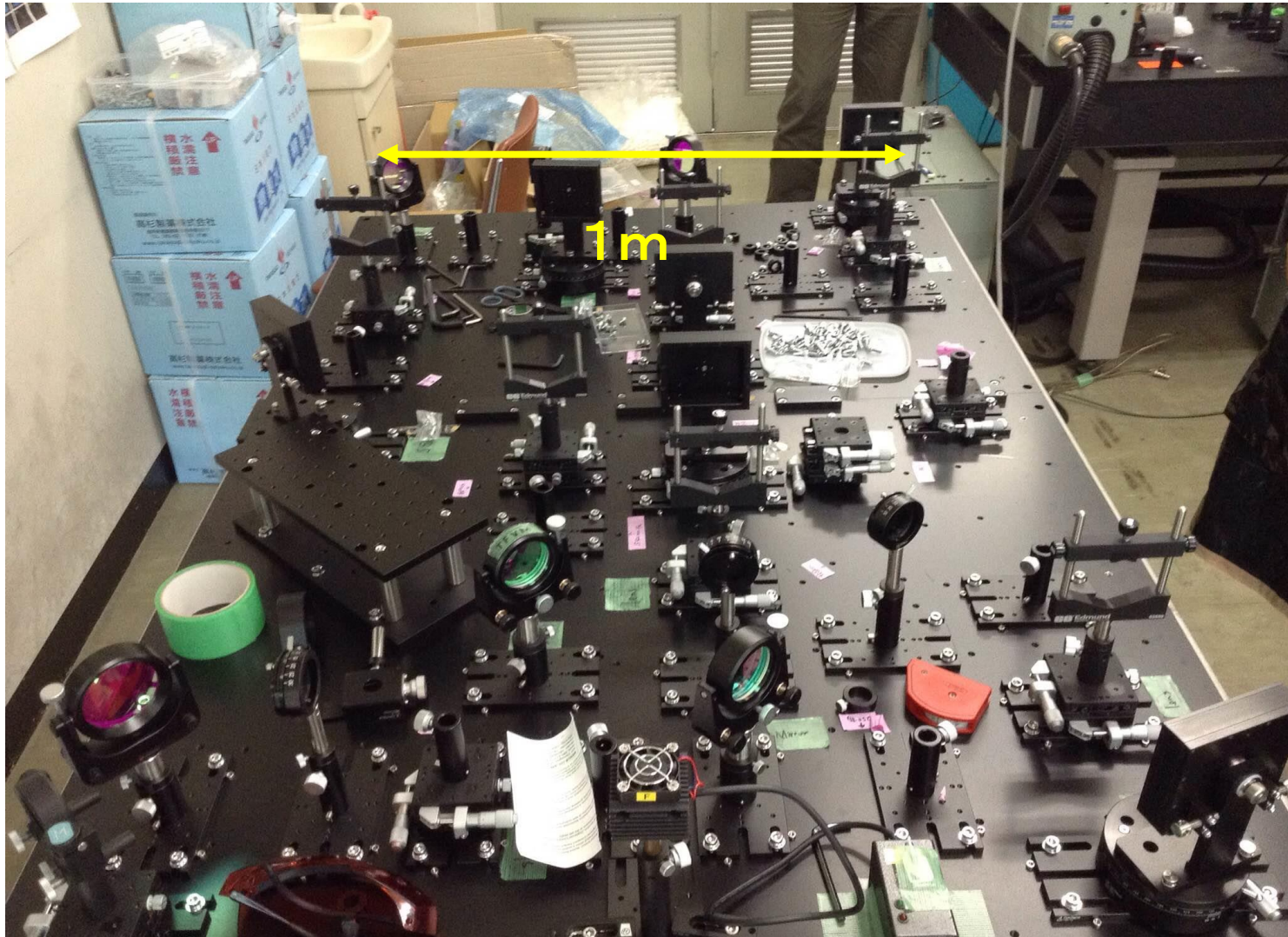


Cut wavelength width :  $\pm 14 \text{ pm}$  ( $\pm 0.5 \text{ cm}^{-2}$ )

Spectral resolution : 18 pm

# Development of LTS system for Sn plasmas

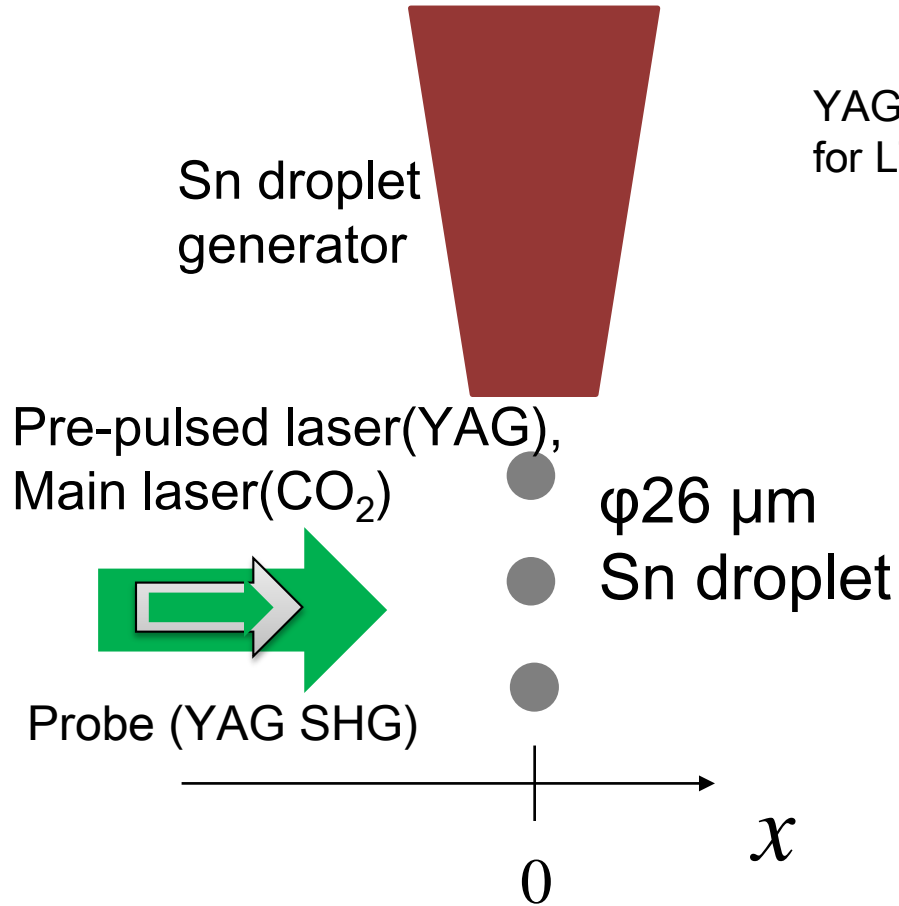
To overcome problems...



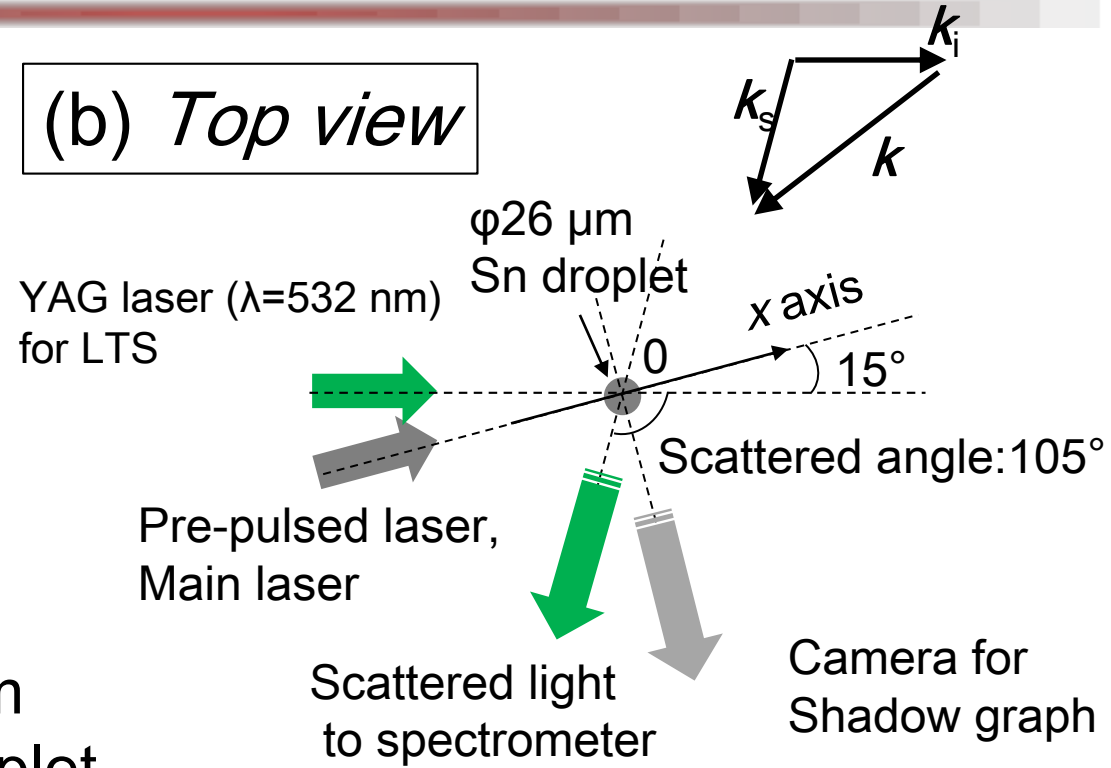


# Experimental setup for EUV Sn plasma

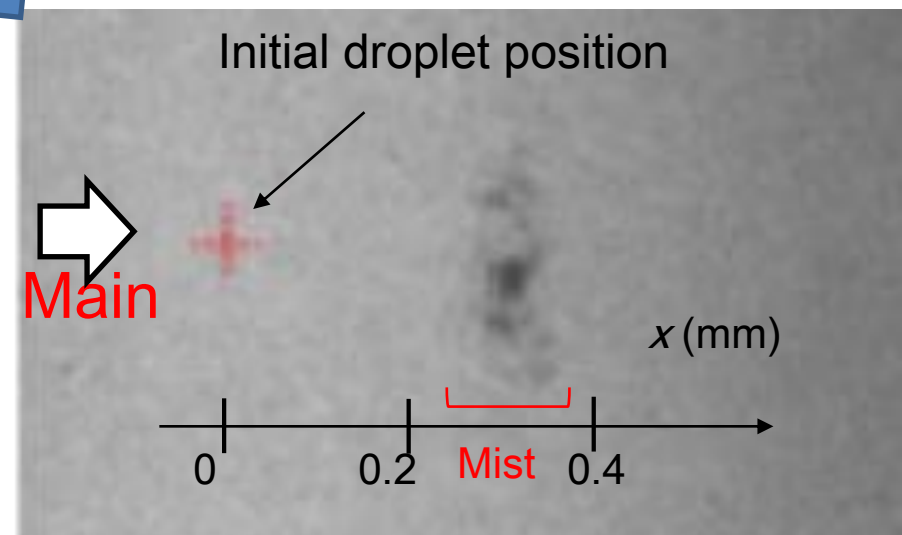
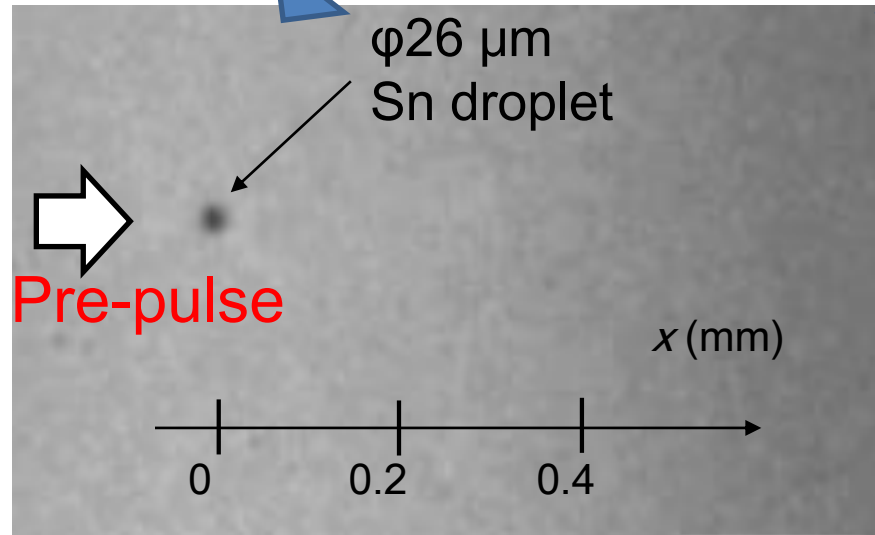
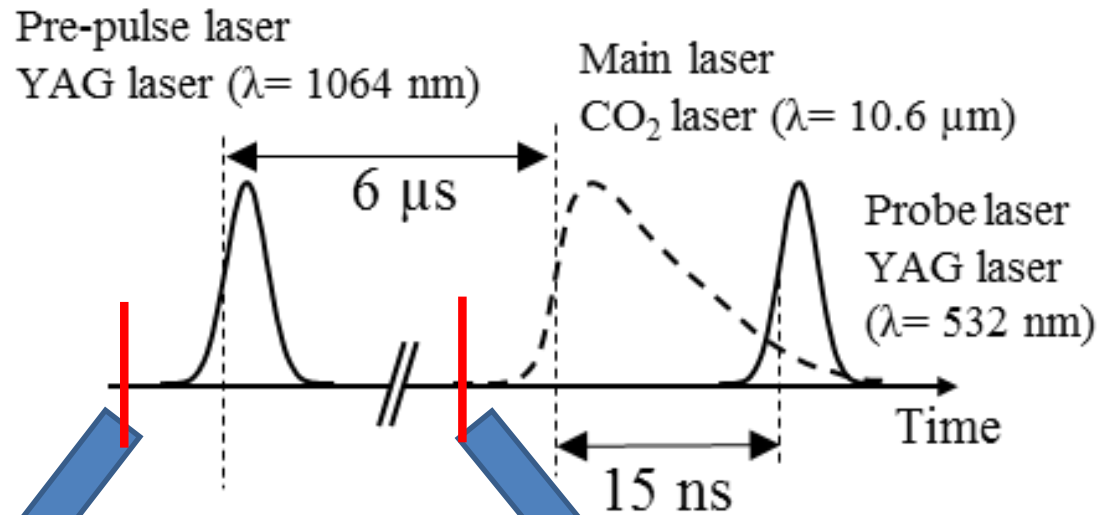
(a) *Side view*



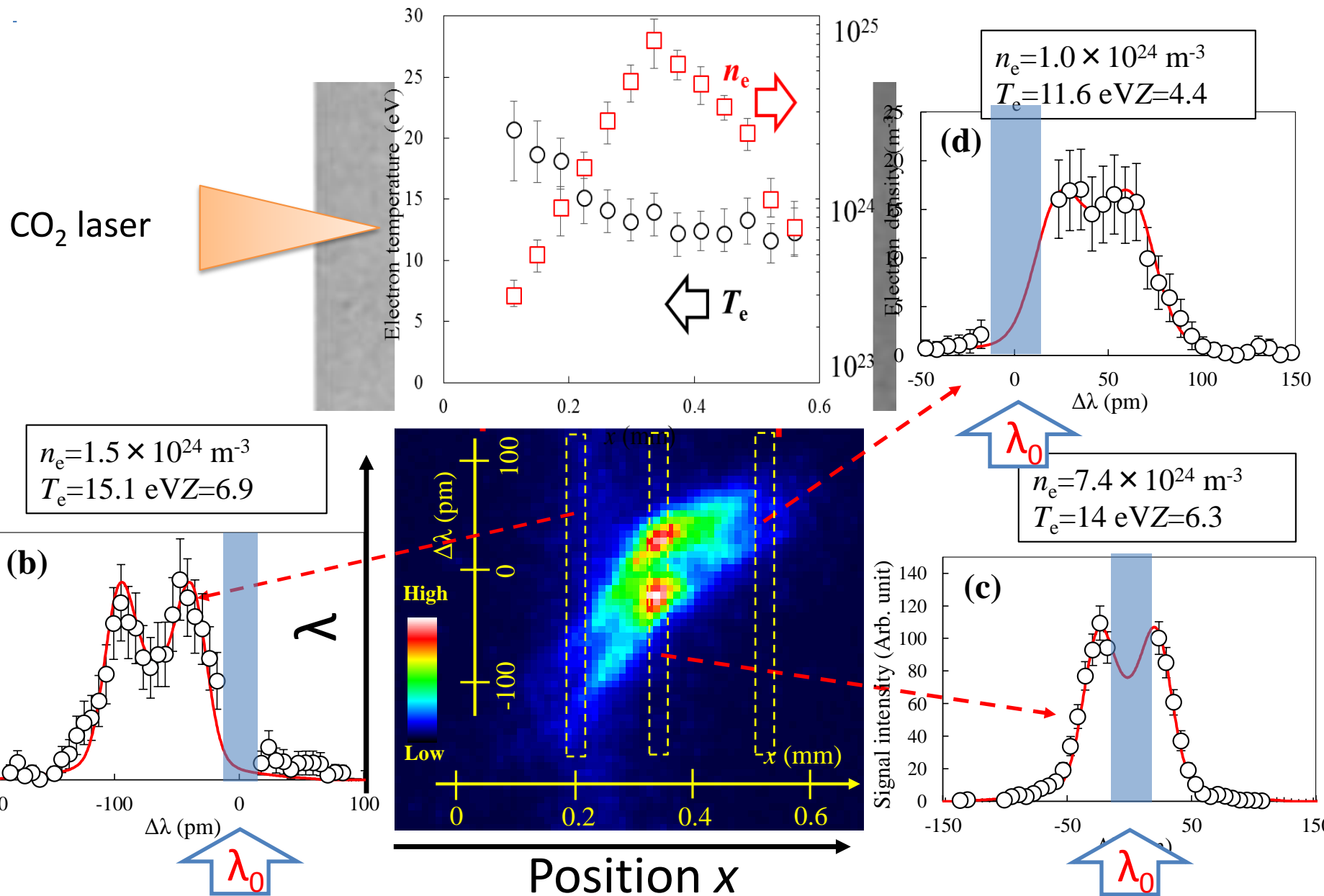
(b) *Top view*

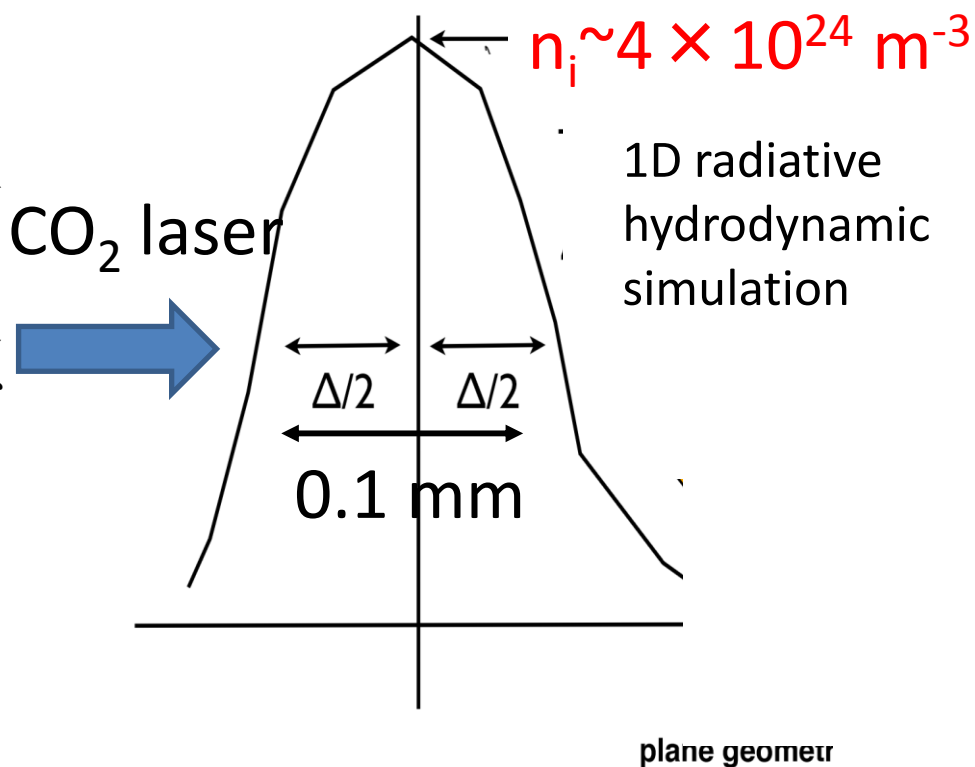
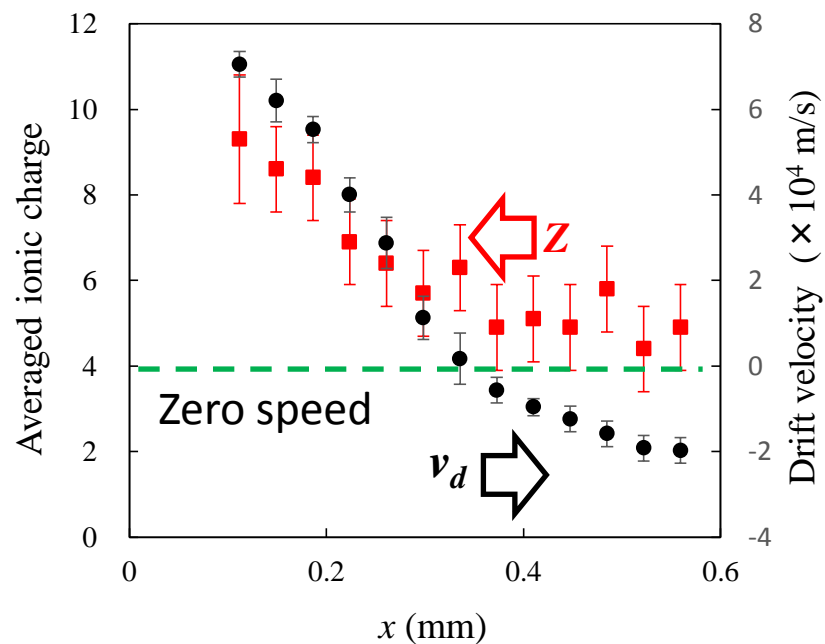
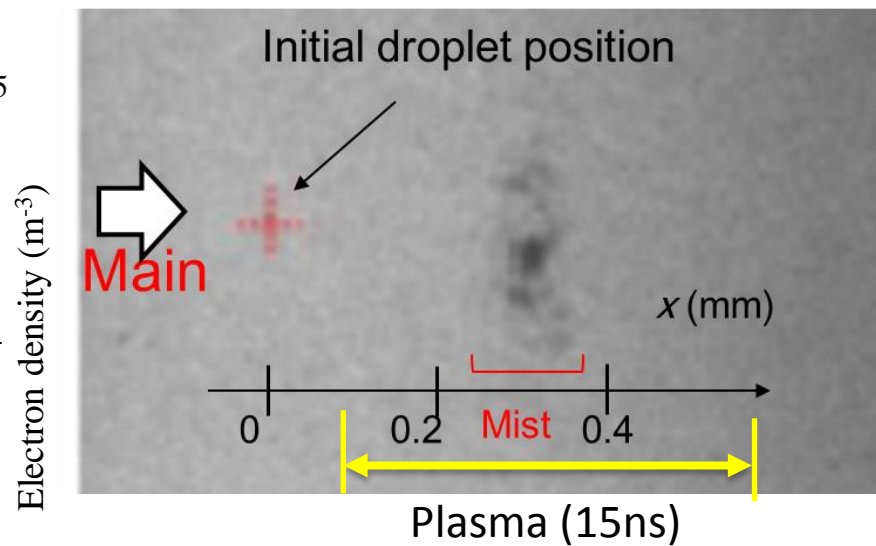
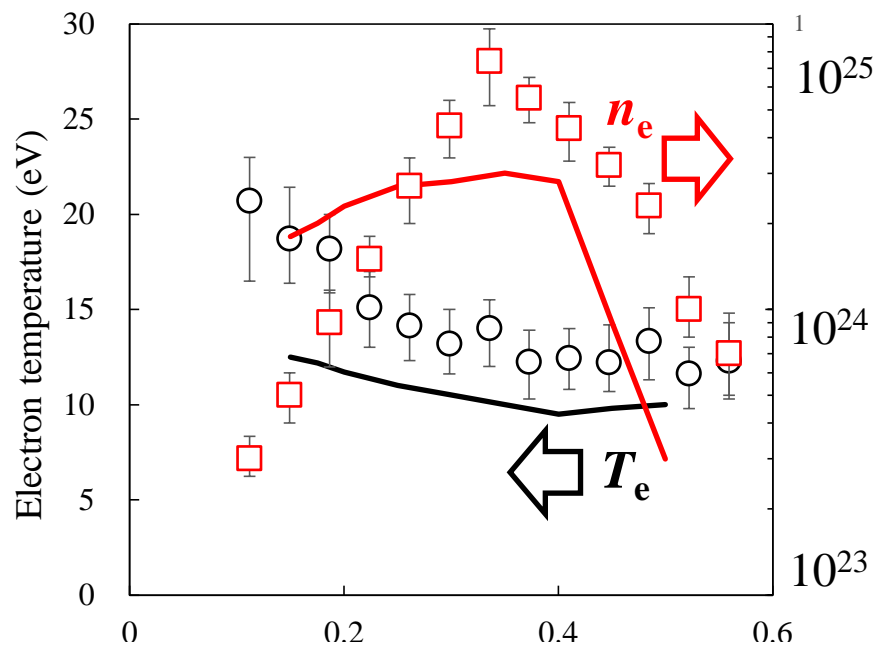


# Time sequence of three lasers



# Results of LTS





# Conclusion

1. Thomson scattering system for EUV light source plasmas has been developed. The spatial distributions of  $n_e$ ,  $T_e$ ,  $Z$ , and  $v_d$ , along the probing laser path, has become possible.
2. The structure of laser-produced Sn droplet plasmas for EUV light sources was clarified as the spatial profiles of  $n_e$  and  $T_e$ .
3. The LTS results was compared with the one-dimensional radiative hydrodynamic simulations. The result mentioned that the condition of the initial  $n_i$  is essential to control  $T_e$ .

**More details: K. Tomita et. al. *Applied Physics Express*, 8 126101 (2015)**

Under investigation...

Pre-pulsed laser conditions, delay timings, time-resolved 2D